A Web-Based Learning System: Supporting Students’ Metacognition by Reflective Prompts

Abstract:
In hypermedia environments, it is important for students to have metacognitive skills while planning, monitoring and evaluating the learning process, since they have more responsibility compared to the traditional learning process. One of the metacognitive activities which could be integrated into web-based learning environments in order to lead students to think about issues such as what, why and how to learn and in what issues they have learning deficiencies is reflective prompts. Reflective prompts support students in effective learning by enabling them to think about their own learning process and to become aware of how they accomplish a task. This article presents a web-based learning environment, which was designed to support students’ metacognitive process by reflective prompts. In the study, the development stages of a goal-based learning environment which contains “web designing by using HTML language” is explained. Then, the general characteristics of the system along with its flow cycle are presented. In addition, the technologies used are summarized through discussing the usages of reflective prompts and other metacognitive tools in the environment.

Introduction
In hypermedia, students have more responsibility in learning process compared to the traditional learning environments in issues such as what to learn, how to learn it, how much time to spend on it, how to access instructional materials related to her/his learning goals, determine which strategies to use (Azevedo et al., 2007; Azevedo, 2005, Azevedo and Cromley, 2004, Pintrich 2000). However, cognitive and educational research has shown students’ inability to being aware of their own cognitive processes, evaluate these processes and to regulate their learning (Azevedo et al., 2007, Azevedo, 2005). Individuals’ planning the learning process to reach an objective or a goal, monitoring their understanding, evaluating the process and making regulations in their plans, strategies etc. based on this evaluation is often described as metacognition (Flavell, 1976). Metacognition is the high level thinking processes which include the active control of thinking processes needed in learning (Livinston, 1997) and means thinking about the thinking which is used to assist students to learn how to learn (Wellman, 1985, p. 1).

One of the widespread activities used to improve individuals' metacognitive skills is asking students questions which will allow them to reflect their thinking processes in the learning process. Reflective prompts, or metacognitive prompts, is based on the concept of self-reflection which was presented by Dewey in 1910s in his book "How We Think?". Reflection is a critical component of metacognition in which people review previous actions and decisions, think about the processing of information on learning task and evaluate how s/he performed it (Goodman et al., 1998; Boud et al., 1985). Reflection, which is an important component of learning and teaching environments, enables the student to think about his/her learning and supports the student to learn more effectively by leading the student towards thinking more strategically. The reflection skill, in the learning objective taxonomies of Bloom (1956) or Biggs (1999, s.37), has been associated with the higher levels of learning (King, 2002). Biggs (1999) concludes that reflection is indicative of deep learning and surface learning will occur when teaching and learning activities such as reflection are missing. Reflective thinking, by enabling the individual to better understand what s/he knows and to discover how s/he accomplishes a task, helps the individuals to focus on the necessary knowledge and beliefs (Shön, 1987). Thus, establishing self-reflective activities in a learning environment has the capacity to increase the learning benefit of the exercises since it gives the opportunity to review previous actions and decisions before proceeding to the next stage. Consequently it enables students to make more sophisticated decisions (Goodman et al., 1998). Reflective prompts are one of the self-reflective activities which support students' learning processes and metacognition by activating students' self-monitoring and self-evaluating processes.

Reflective prompts consist of questions aim:
- to define mental activities of students that they have realized or they will realize in the learning process,
- to evaluate their characteristics, or thinking processes or learning strategies that they use in the learning process,
- and based on these evaluations, to define the regulations which could improve the quality of the learning process or the quality of its products (Wetzstein & Hacker, 2004).

Reflective prompts should be directed towards high level thinking (analysis, synthesis and evaluation) (Üver, 2003, p. 23). Low level questions, or questions which require recall inhibit reflective thinking (Shermis, 1992, p.48). Moreover, it is important for reflective prompts to be open-ended, to lead problem solving and enabling people to make judgments (Bağcioğlu Üver, 2002, s.37)
Students make reflections during the learning process by asking themselves several questions. These questions provide students with information about what, when, why and how to learn; to what extent and how they learned something; and in what issues they have learning deficiencies. Reflective prompts also enable students to evaluate themselves. In addition, the teacher can prompt students' reflective thinking by asking questions (Ünver, 2003, p. 25).

Question prompts have a positive effect on learning by helping students reflect upon and monitor their problem-solving processes, and explain and justify their solutions students (Lin & Lehman, 1999; Scardamalia, Bereiter & Steinbach, 1984; Scardamalia, Bereiter, McLean, Swallow & Woodruff, 1989). They can help learners to elaborate thinking, make inferences, and additionally and importantly, monitor and evaluate their learning process (Lin, Hmelo, Kinzer & Secules, 1999).

In a hypermedia learning environment, reflection process enhances students' ability to learn from their own experiences and helps them to reach better learning outcomes by enabling them to make more advanced monitoring (Hartman, 1998). To help to activate students’ reflection on the learning tasks and their deep processing of information (Bannert, 2003; Bannert, 2007), it is important to integrate reflective prompts with learning environments and curricula. The aim of this study is to constitute an example about designing and developing a web-based learning environment aimed at using reflective prompts for the purposes of planning and evaluation.

**Learning Material**

*The Development Stages of the Learning Material*

The following stages have been followed in this study in order to design an environment which would provide students metacognitive support while they are studying in web-based learning environments.

1. Firstly, it was decided to include **reflective prompts** in the learning environment which -by observing their learning process- enable students to comprehend how they perform a task and consequently enable them to think more strategically in the subsequent activities.
2. Then, the criteria were set about generating reflective prompts after analyzing the literature on them.
3. The general structure of the environment and weekly flow cycle were decided after defining the components of the learning environment. It was determined that the environment should be designed as goal-based, and reflective prompts directed towards planning and evaluation related to tasks should be present in the environment each week.
4. In line with the criteria determined after the analyses of literature on reflective prompts, these reflective prompts, which would be answered before and after the accomplishment of the task, were prepared and appealed to expert opinion. After we obtained the expert opinion, we made the final regulations on the reflective prompts.
5. The environment was designed according to the plan. A suitability form about the environment was prepared and sent to the expert opinion. Necessary adjustments were made in line with the experts' opinions.
6. The system was introduced to the eight students who had taken the Introduction to Computer II course in the previous year, and the environment was given its final form according to the feedback received from them.

*The General Characteristics of the Learning Material*

The learning environment contains four-week content in the Chapter on “Web Design” of the Introduction to Computer II Course. The main reason to define the content as “web designing by using HTML language” was that metacognitive skills are used more effectively especially in the process of learning complex information. It is thought that the information which includes both knowledge and skill are more complex, since they allow direct observation of whether the information is used correctly or not (Kragier, Ford and Salas, 1993). Metacognitive skills, for the information which include both knowledge and skill, enable the individual to notice whether s/he lacks knowledge or skill and to make necessary regulations accordingly. Web designing is considered to be a complex skill since it requires both knowledge and skill, and obligates individuals to integrate different components. The weekly flow cycle of to the web-based learning environment designed for this study is shown in the Figure 1.
A Goal Based Scenario

As seen on Figure 1, the learning environment is designed as goal-based. Individuals begin learning in the real life through a need, and then they start to seek for the necessary knowledge to meet this need. In addition, individuals may perform necessary metacognitive activities to accomplish the task which is directed towards a certain goal or a problem. Comparing students in terms of problems and motivating them towards struggling for finding solutions is also important for them to proceed to reflective thinking (Ünver, 2003, s.35). Therefore, in the developed learning material, each week, the task of that week pops up on the screen as students login to the system, students may save that task on their computers after examining it, or they may view their tasks whenever they want when working with the software from the My Tasks Menu.

Reflective prompts for planning

After they view and glance the task, the screen (Figure 2) pops up which contains reflective prompts aimed at planning in order for students to define how to approach the task after analyzing their previous experiences and the structure of the learning task. These prompts are designed to enable students to make plans.
in advance about the studying process instead of immediately starting to study, such as what topics s/he needs to learn or whether these topics are similar to the topics studied before. The system does not allow a question to be left unanswered. It is thus thought that the student will develop more accurate studying strategies while planning such questions each week and will be in the habit of making such plans.

Reflective prompts should enable students to present their metacognitive knowledge. Flavell (1979) argues that the metacognitive knowledge can be handled in three main categories; person, task and strategy (cited by Gama, 2004). The person category consists of the individual's beliefs related to his/her own and other individuals' cognitive processes. The task category is the individual's evaluations about the task that s/he engaged with at that moment. The strategy category consists of the individual's knowledge about what strategies would be effective to accomplish goals or sub-goals (Gama, 2004). Hence, reflective prompts have been formulated in this study which are directed towards these three categories that an individual should consider in order to accomplish the task. Some of these prompts are as follows:

“What should you know about web design in order to accomplish this task?”
“Do you have previous knowledge which might help you to accomplish the task? If you do, what are they?”
“How a path should you follow to accomplish the task? Do you take your previous experiences into consideration while defining this path?”
“Does the content of this task show similarity to what you have studied before? If it does, in what respects?”

Figure 2. Task viewing and reflective prompts for planning how to approach the task

Studying Environment

After students answer the reflective prompts, they become able to proceed to the studying environment which includes the content about all four-weekly tasks. The interface of the software is as seen on the Figure 3. On the left side of the software is the content map, on the upper right side there is a breadcrumb list of representing the subject, and help and exit links, and on the right side there is the content of the subject clicked on. On the underside, there are My Tasks, Take Notes, Bookmark, What I Have Done, Discussion, Back and Forward buttons, respectively. Students can study any subject they wish which are listed on the content map on the left side of the learning environment. Each subject consists of videos containing voice. Students can stop the video whenever they wish, take the video forward, change the volume settings or rewatch the video by using video controls. The videos firstly cover the subject theoretically (for example “What is frame?”), then they practically show how the output will be by typing codes about the subject covered in the notebook. The student can use “forward” and “back” buttons on the lower right corner of the software as well as the content map for transition between subjects. The software contains 53 subject titles.
The task of that week, which pops up in the first login to the system, can be viewed through using the “My Current Task” sub-menu under the “My Tasks” menu. In addition, by using the “My Previous Tasks” sub-menu, the previous tasks can be viewed and information about academic achievements related to these tasks can be obtained. The answers to the reflective prompts given before working on the current task can be viewed through the “My Thoughts” sub-menu under the “What I Have Done” menu. In addition, by using this menu, not only the answers given before the study but also the answers given after the accomplishment of the previous tasks to evaluate the process can be viewed. Through the My Tasks and My Thoughts menus, students can view their tasks, their achievements in these tasks and their thoughts related to the accomplishment processes, and accordingly evaluate their learning processes. In a system containing reflective prompts, it is crucial to access to these questions and to how and which week s/he answered a question, for a person to extract the maximum benefit from these questions.

Under the “What I Have Done” menu, there are “All My Notes”, “My Bookmarked Pages”, “Pages I Have Visited” and “My Information” sub-menus along with the “My Thoughts” sub-menu. With the “My Information” sub-menu, the process of use of the software can be followed by viewing the duration of navigation through the software, the number of subject titles viewed, and the percentage of the content viewed. With the “Pages I Have Visited” sub-menu, the pages visited can be accessed and the duration of the visit can be seen. With the help of the “Take Notes” sub-menu, notes can be taken related to each subject, the notes can be viewed later (All My Notes), and necessary changes can be made on these notes. Pages can be bookmarked by using the “Bookmark” menu. This button turns into “bookmarked” in the pages which have been bookmarked. Thus, the student can understand as s/he opens the page that this page has been marked as an important page. All the bookmarked pages can be viewed via the “My Bookmarked Pages” sub-menu. Ideas about the studied subjects can be exchanged through the “Discussion” menu. Students, by using the discussion menu, can ask questions about tasks and the learning process, answer others' questions, and view others' questions and answers.

Along with the functions of the system, there are also two different help versions related to the software. The help version which pops up when the user first logs in explains all kinds of actions, screens and menus on the software in a single video. The other help version, which lists help topics what the other help version indicated as a whole, is used after the user starts using the software and the user can visit it whenever s/he wishes. Thus, students can view the topics on which they need help again. The help sections consist of videos containing voice as the subject contents do.

Students, after they study necessary subjects, try to finish the task by opening the notebook, and meanwhile they reuse the software for the issues that they have not understood well.

Sending the Task
Each week, students upload the task to the system after they accomplished it by using the “Send the Task” button under the My Tasks menu.

Reflective prompts for evaluation
After sending the task to the system, the reflective prompts pop up on the screen (Figure 4) for students to evaluate the learning process and the system does not allow these prompts to be left unanswered. These prompts were aimed at enabling students to evaluate the learning process, such as whether s/he studied appropriate subjects to accomplish the task, or whether s/he used the time efficiently.

Some of the questions aimed at the student to evaluate the process are as follows:

- “Have you studied the necessary subject to accomplish the task?”
- “Have you used your time efficiently?”
- “What was the most important information in the subjects you studied?”
- “What strategies have you used to back up your learning? (note taking, summarizing, repetition, etc.)”

**The Technologies Used**

MySQL database was used to form the database and save the data, Dreamweaver was used in creating the web pages and the PHP language was used to transfer records from the software to the database. The contents were prepared by using Camtasia screen recorder software, and the Audition software was used in order to process the sounds in recorded videos. The Photoshop software was used to produce the interface of the software and graphics/drawings to be used in the content.

**Conclusion**

As the effects of metacognitive skills of individuals on the learning process became more obvious in web-based learning environments, the need to design learning environments which will support these skills started to become more significant. This article presents design of a goal-based educational hypermedia environment, which aims at supporting students’ metacognition by reflective prompts. In this learning environment, students answered reflective prompts each week, both before the task towards planning and after the accomplishment of the task towards evaluation, and they accessed to their answers to these prompts whenever they wish.

In the further studies, it is believed that designing and developing learning environments which contain reflective prompts not only directed towards planning and evaluation but also towards monitoring during the learning process and experimental studies to be conducted in these environments will be worthwhile. It is also believed that designing learning environments to analyze the students’ answers to reflective prompts by the system (intelligent systems) and giving students’ feedback after these analyses will help students to reflect themselves.

**References**


